PATENT ABSTRACTS OF JAPAN

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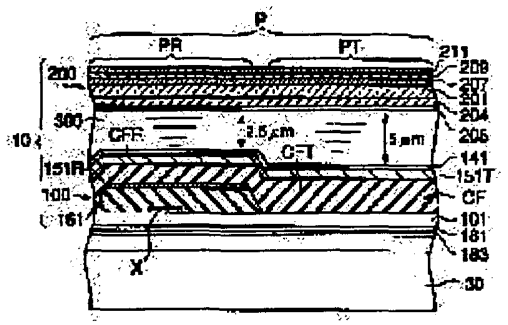
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a liquid crystal display device capable of efficiently using backlight for a transmissive display in dark space, besides, efficiently using external light for a reflective display in bright space, reproducing excellent colors in both cases and reducing the power consumption.
SOLUTION: A reflection part PR and a transmission part PT are provided in one pixel region P. In a bright space, pictures are displayed by selectively reflecting external light with the reflection part PR. In a dark space, the pictures are displayed by selectively transmitting backlight emitted from a backlight unit 30 with the transmission part PR. Film thickness of a color filter CFR in the reflection part PR is made thinner than that of a color filter CFT in the transmission part PT. Thereby, a spectral transmission factor of the color filter CFR is made higher than that of the color filter CFT.



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CLAIMS

[Claim(s)]
[Claim 1] The 1st substrate which has the pixel electrode which consists of the reflector and transparency electrode which were electrically connected to the switching element arranged at the intersection of the scanning line arranged by the line writing direction on 1 principal plane, the signal line arranged in the direction of a train so that it might intersect perpendicularly with these scanning lines, the aforementioned scanning line, and a signal line, and the aforementioned switching element. The 2nd substrate which has the counterelectrode arranged on 1 principal plane. The liquid crystal constituent pinched between the 1st substrate of the above, and the 2nd substrate. It is the liquid crystal display equipped with the above, and the pixel field divided by the aforementioned scanning line and the signal line is equipped with the reflective section which has a light filter and a reflector, and the transparency section which has a light filter and a penetrated type electrode, and optical density of the light filter of the aforementioned reflective section is characterized by differing from the optical density of the light filter of the aforementioned transparency section.
[Claim 2] The spectral transmittance of the light filter of the aforementioned reflective section is a liquid crystal display according to claim 1 characterized by being higher than the light filter of the aforementioned transparency section.
[Claim 3] The thickness of the light filter of the aforementioned reflective section is a liquid crystal display according to claim 1 characterized by being thinner than the light filter of the aforementioned transparency section.
[Claim 4] The ratios d1/d2 of the thickness d1 of the light filter of the aforementioned reflective section and the thickness d2 of the light filter of the aforementioned transparency section are liquid crystal displays according to claim 1 characterized by being less than one.
[Claim 5] The thickness of the light filter of the aforementioned reflective section is a liquid crystal display according to claim 1 characterized by being [of the thickness of the light filter of the aforementioned transparency section] 1/2 substantially.
[Claim 6] The ratios dc1/dc2 of the thickness dc1 of the liquid crystal constituent pinched between the 1st substrate of the above and the 2nd substrate in the aforementioned reflective section and the thickness dc2 of the liquid crystal constituent in the aforementioned transparency section are liquid crystal displays according to claim 1 characterized by being /2 substantially (2N+1) when N is made into the natural number.
[Claim 7] The position of the inferior surface of tongue of the light filter in the aforementioned reflective section is a liquid crystal display according to claim 1 characterized by 1 or the thing high 5 micrometers from the position of the inferior surface of tongue of the light filter in the aforementioned transparency section.
[Claim 8] The aforementioned reflective section is a liquid crystal display according to claim 1 characterized by equipping the lower layer of a reflected type electrode with a bump.
[Claim 9] The aforementioned bump is a liquid crystal display according to claim 8 characterized by having 1 or the thickness of 5 micrometers.
[Claim 10] The 1st substrate of the above is a liquid crystal display according to claim 1 characterized by having had the bump, the reflector prepared on this bump, and the light filter prepared on this reflector in the reflective section of the aforementioned pixel field, and having a light filter with thickness thicker than the light filter of the aforementioned reflective section, and the transparency electrode prepared on this light filter in the transparency section of the aforementioned pixel field.
[Claim 11] It is the liquid crystal display according to claim 1 characterized by having equipped the 1st substrate of the above with the reflector in the reflective section of the aforementioned pixel field, having equipped it with the light filter and the transparency electrode prepared on this shell filter in the transparency section of the aforementioned pixel field, and for the 2nd substrate of the above having countered the reflective section and the transparency section of the

aforementioned pixel field, and having the light filter of almost uniform thickness.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to a liquid crystal display, and relates to the transflective type electrochromatic display display which has the transparency section which displays a picture by reflecting outdoor daylight in a 1-pixel field especially by penetrating the reflective section and back light light which display a picture.
[0002]
[Description of the Prior Art] It has the liquid crystal constituent pinched between the array substrate which has the pixel electrode connected electrically generally to the switching element arranged near the intersection of the scanning line arranged so that a liquid crystal display might intersect perpendicularly mutually, and a signal line, and this switching element, the opposite substrate which has a counterelectrode, and an array substrate and an opposite substrate. In addition to these composition, electrochromatic display display equips the array substrate side with the light filter of almost uniform thickness.
[0003] Transflective type electrochromatic display display is equipped with the reflective section and the transparency section in the 1-pixel field. The reflective section has reflectors, such as an aluminum film arranged at the lower layer of a light filter. The transparency section has transparency electrodes, such as indium-teens-oxide, i.e., an ITO film etc., arranged at the upper layer of the light filter of the almost same thickness as the reflective section. A reflector and a transparency electrode are pixel electrodes connected to the switching element, and the same voltage is supplied.
[0004] Such transflective type electrochromatic display display has the merit which can reduce power consumption sharply in a dark place by turning on a back light, making it function as a penetrated type liquid crystal display which displays a picture using the transparency section in a pixel field, and making it function as a reflected type liquid crystal display which displays a picture by reflecting outdoor daylight using the reflective section in a pixel field in a bright place.
[0005]
[Problem(s) to be Solved by the Invention] However, the following problems arise in such a transflective LCD. That is, when reflecting outdoor daylight and displaying a picture, outdoor daylight passes twice the light filter prepared on the reflector. On the other hand, when penetrating back light light and displaying a picture, back light light passes only once the light filter prepared in the bottom of a transparency electrode.
[0006] When the reflective section and the transparency section in a pixel field of the thickness of a light filter are uniform (i.e., when the optical density of the light filter of the reflective section and the transparency section is fixed), at the time of a reflective display, as compared with the time of a transparency display, it becomes twice [about] as many optical density as this, and brightness falls remarkably. For this reason, the color-reproduction range at the time of a reflective display becomes very small. Therefore, it is difficult to be [both] compatible in a good color reproduction at the time of a transparency display and a reflective display.
[0007] This invention is made in view of the trouble mentioned above, while the purpose uses the back light light for a transparency display effectively in a dark place, the outdoor daylight for a reflective display is used effectively in a bright place, and a good color reproduction is both made possible, and it is in offering the liquid crystal display which can reduce power consumption.
[0008]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem and to attain the purpose, a liquid crystal display according to claim 1 The scanning line arranged by the line writing direction on 1 principal plane, the signal line arranged in the direction of a train so that it might intersect perpendicularly with these scanning lines, The 1st substrate which has the pixel electrode which consists of the reflector and transparency electrode which were

electrically connected to the switching element arranged at the intersection of the aforementioned scanning line and a signal line, and the aforementioned switching element, In the liquid crystal display equipped with the liquid crystal constituent pinched between the 2nd substrate which has the counterelectrode arranged on 1 principal plane, and the 1st substrate of the above and the 2nd substrate The pixel field divided by the aforementioned scanning line and the signal line It has the reflective section which has a light filter and a reflector, and the transparency section which has a light filter and a penetrated type electrode, and optical density of the light filter of the aforementioned reflective section is characterized by differing from the optical density of the light filter of the aforementioned transparency section.
[0009]
[Embodiments of the Invention] Hereafter, the gestalt of 1 operation of the liquid crystal display of this invention is explained with reference to a drawing.
[0010] Drawing 1 is the perspective diagram showing roughly an example of the liquid crystal display panel applied to the liquid crystal display of this invention.
[0011] The liquid crystal display concerning the gestalt of 1 implementation of this invention is active-matrix type transflective type electrochromatic display display, and is equipped with the liquid crystal display panel 10 and the back light unit 30.
[0012] The liquid crystal display panel 10 is equipped with the liquid crystal constituent arranged between the array substrate 100 as the 1st substrate, the opposite substrate 200 as the 2nd substrate by which opposite arrangement was carried out at this array substrate 100, and the array substrate 100 and the opposite substrate 200 as shown in drawing 1 . In such a liquid crystal display panel 10, the display area 102 which displays a picture was formed in the field surrounded by the sealant 106 which sticks the array substrate 100 and the opposite substrate 200, and is equipped with two or more pixel fields. The circumference area 104 which has the various circuit patterns pulled out out of the display area 102 is formed in the field of the outside of a sealant 106.
[0013] As the display area 102 of the array substrate 100 is shown in drawing 2 or drawing 4 The m scanning lines Y1-Ym by which the transparent insulating substrate, for example, thickness, was formed along with the line writing direction of the pixel electrode 151 of the mxn individual arranged in the shape of a matrix, and these pixel electrode 151 on the glass substrate 101 which is 0.7mm, n signal lines X1-Xn formed along the direction of a train of these pixel electrode 151, It corresponds to the pixel electrode 151 of a mxn individual. near the intersection position of the scanning lines Y1-Ym and signal lines X1-Xn as a nonlinear switching element It has TFT 121 of the arranged mxn individual, i.e., TFT, the scanning-line drive circuit 18 which drives the scanning lines Y1-Ym, and the signal-line drive circuit 19 which drives these signal lines X1-Xn.
[0014] The scanning line is formed of low electrical resistance materials, such as aluminum and a molybdenum-tungsten alloy. The signal line is formed of low electrical resistance materials, such as aluminum.
[0015] As shown in drawing 3 and drawing 4 , the pixel field P is equivalent to the field divided by the scanning line Y prepared in general in the array substrate 100, and the signal line X. The 1-pixel field P has the transparency section PT which displays a picture by reflecting outdoor daylight alternatively by penetrating alternatively the back light light from the reflective section PR and the back light unit 30 which displays a picture.
[0016] In order to realize color display, the light filter CF colored three primary colors is formed in each [these] pixel field. With the gestalt of this operation, the light filter CF colored red, green, and blue is formed in the red pixel field, the green pixel field, and the blue pixel field, respectively, for example. This light filter 203 is formed with the resin which distributed the pigment of for example, each color component.
[0017] The back light unit 30 shown in drawing 4 is arranged at the tooth back of the array substrate 100 in a liquid crystal panel 10. This back light unit 30 has optical sheets, such as a prism sheet arranged between the light guide plate which has the cross section of a wedge action die, the light source arranged in the unilateral side of this light guide plate, the reflecting plate surrounding this light source, and a light guide plate and an array substrate, etc., and is constituted.
[0018] The reflective section PR is equipped with the bump 161 formed of the acrylic resin resist, and reflector 151R formed with metallic-reflection films, such as aluminum prepared on this bump 161. The light filter CFR is formed on reflector 151R.
[0019] The transparency section PT is equipped with a light filter CFT and transparency electrode 151T which were formed of transparent conductivity members prepared on this light filter CFT, such as indium-teens-oxide, i.e., ITO etc. These transparency electrode 151T are arranged to the whole 1-pixel field with which the reflective section PR and the transparency section PT were doubled.
[0020] Reflector 151R and transparency electrode 151T function as a pixel electrode 151 electrically connected to the source electrode of TFT121.
[0021] The thickness d1 of the light filter CFR of the reflective section PR is thinner than the thickness d2 of the light

filter CFT of the transparency section PT, and the ratios d1/d2 with thickness d1 and d2 are less than one. In the transparency section PT, since the outdoor daylight from the opposite substrate 200 side will carry out two-times passage of the light filter CFR in the reflective section PR to back light light penetrating a light filter CFT only once, the thing of the thickness d2 of a light filter CFT for which the thickness d1 of a light filter CFR sets about 1/to 2 is desirable.
[0022] Thus, spectral transmittance as shows the optical density of a light filter CFR to drawing 5 unlike the optical density of a light filter CFT is obtained by making thickness of the light filter CFR in the reflective section PR thinner than the thickness of the light filter CFT in the transparency section PT.
[0023] By drawing 5 , a thin line shows the spectral transmittance of the light filter CFR in the reflective section PR, and a thick line shows the spectral transmittance of the light filter CFT in the transparency section PT by it.
[0024] As shown in drawing 5 , the spectral transmittance RR of the red light filter in the reflective section PR is higher than the spectral transmittance radiographic of the red light filter in the transparency section PT. Moreover, the spectral transmittance GR of the green light filter in the reflective section PR is higher than the spectral transmittance GT in the transparency section PT. Furthermore, the spectral transmittance BR of the blue light filter in the reflective section PR is higher than the spectral transmittance BT in the transparency section PT.
[0025] Thus, it comes to have smaller optical density, i.e., higher spectral transmittance, by making thickness of the light filter CFR in the reflective section PR thinner than the thickness of the light filter CFT in the transparency section PT.
[0026] TFT121 uses as a gate electrode the portion which projected from the scanning line Y, and has the semiconductor film formed on this with the amorphous silicon film by which the laminating was carried out through the gate insulator layer, the polysilicon contest film, etc. The semiconductor film is electrically connected to the pixel electrode 151 through the low resistance semiconductor film and the source electrode. Moreover, the semiconductor film is electrically connected to the drain electrode which extended from the signal line X through the low resistance semiconductor film. In the example shown in drawing 3 and drawing 4 , TFT121 is arranged at the lower layer of the bump 161 near the intersection of a signal line X and the scanning line Y.
[0027] Reflector 151R as a pixel electrode 151 contacts a source electrode through the contact hole formed in the bump 161 on the source electrode of TFT121, and is connected electrically. Moreover, transparency electrode 151T as a pixel electrode 151 contact a source electrode through the contact hole formed in the bump 161 and light filter CFR on the source electrode of TFT121, and are connected electrically.
[0028] The front face of transparency electrode 151T is being worn with the orientation film 141 for carrying out orientation of the liquid crystal constituent 300 which intervenes between the opposite substrates 200.
[0029] Each TFT121 is used as a switching element which impresses the potential of the signal lines X1-Xn driven by the signal-line drive circuit 19 to the pixel electrode 151 of these correspondence line, when the correspondence scanning line drives by the scanning-line drive circuit 18 and the pixel electrode 151 of a correspondence line is chosen.
[0030] The scanning-line drive circuit 18 supplies scanning voltage to the sequential-scanning lines Y1-Ym a horizontal scanning period, and the signal-line drive circuit 19 supplies a pixel signal level to signal lines X1-Xn in each horizontal scanning period.
[0031] Although it does not illustrate in detail by this liquid crystal display panel 10 since the dimension, especially frame size of a liquid crystal display are constituted small as shown in drawing 1 , a signal line It is pulled out only at the 1st **** 100X side of circumference area 104X of the array substrate 100. It connects with X control circuit substrate 421 including the signal-line drive circuit 19 which supplies image data to a signal line through X-TAB 401-1,401-2,401-3,401-4 by this 1st **** 100X side.
[0032] Moreover, the scanning line is also pulled out only at the 2nd **** 100Y side which intersects perpendicularly with 1st **** 100X in circumference area 104X of an array substrate, and is connected to Y control circuit substrate 431 including the scanning-line drive circuit 18 which supplies a scanning pulse to the scanning line by this 2nd **** 100Y side through Y-TAB 411-1,411-2.
[0033] The display area 102 of the opposite substrate 200 is equipped with the counterelectrode 204 arranged on the transparent insulating substrate 201, for example, the glass substrate whose thickness is 0.7mm, as shown in drawing 2 or drawing 4 .
[0034] This counterelectrode 204 is formed by the transparent conductivity member which forms the potential difference between the pixel electrodes 151, for example, ITO. Moreover, the front face of this counterelectrode 204 is being worn with the orientation film 205 for carrying out orientation of the liquid crystal constituent 300 which intervenes between the array substrates 100.
[0035] A counterelectrode 204 counters two or more pixel electrodes 151, and is set as a reference potential. It is

prepared in order that the silver paste as the electrode transition material, i.e., transfer, arranged around a substrate may supply voltage to the opposite substrate 200 from the array substrate 100, and a counterelectrode 204 is driven by the counterelectrode drive circuit 20 connected through transfer.

[0036] The liquid crystal capacity CL is formed by the liquid crystal layer 300 pinched between the pixel electrode 151 and the counterelectrode 204.

[0037] The array substrate 100 is equipped with the electrode of the couple for forming the auxiliary capacity CS in parallel electrically with the liquid crystal capacity CL. That is, the auxiliary capacity CS is formed of the potential difference formed between the pixel electrode 151, the auxiliary capacity electrode 61 of this potential, and the auxiliary capacity line 52 set as predetermined potential.

[0038] lambda/4 wavelength plate 181 and the polarizing plate 183 are arranged by the superficies of the glass substrate 101 of the array substrate 100. The diffusion board 207, lambda/4 wavelength plate 209, and the polarizing plate 211 are arranged by the superficies of the glass substrate 201 of the opposite substrate 200. As for the deviation side of polarizing plates 183 and 211, the optimal direction is chosen according to the display mode of a liquid crystal display, the twist angle of a liquid crystal constituent, etc.

[0039] The gap of the liquid crystal layer thickness by which the liquid crystal constituent 300 is pinched, i.e., the predetermined width of face formed between the array substrate 100 and the opposite substrate 200, is secured by the spacer arranged to non-pixel fields, such as circuit patterns, such as a signal line X and the scanning line Y, TFT121, the pixel electrode 151, and the circumference frame section.

[0040] This liquid crystal layer thickness is about 5 micrometers in the transparency section PT of the pixel field P in the example shown in drawing 4 .

[0041] the position of the inferior surface of tongue of the light filter [in / the transparency section PT / in the position of the inferior surface of tongue of the light filter / in / the reflective section PR / since the lower layer of reflector 151R and reflector 151R is equipped with the bump 161 who has about 1 or the thickness of 5 micrometers in the reflective section PR of the pixel field P] CFR] CFT -- 1 -- or it is high 5 micrometers Although the thickness of a light filter CFR is about 1 of thickness of light filter CFT/2, since the thickness of a bump 161 and reflector 151R is 1/2 or more [of the thickness of a light filter CFT], it is 1/2 of the liquid crystal layer thickness of the transparency section PT, i.e., about 2.5 micrometers, in general in the example which liquid crystal layer thickness became thinner than the transparency section PT, and was shown in drawing 4 .

[0042] An example of the optimal relation between the thickness of the light filter CF to a bump's 161 height and liquid crystal layer thickness is shown in drawing 6 . The solid line L1 in drawing 6 shows the thickness of a light filter, and a dashed line L2 shows liquid crystal layer thickness. If based on the relation shown in drawing 6 , in the transparency section PT, liquid crystal layer thickness will be 5 micrometers, and the thickness of a light filter CFT will be about 3 micrometers. Moreover, in the reflective section PR, liquid crystal layer thickness is 2.5 micrometers, the thickness of a light filter CFR is about 1 micrometer, and a bump's 161 height is about 5 micrometers.

[0043] Next, the manufacture method of this liquid crystal display is explained.

[0044] That is, membranes are formed, respectively and patterning of the aluminum film which forms the amorphous silicon film, the low resistance semiconductor film, the signal line X, the source electrode 131, and the drain electrode 132 as the aluminum which forms the scanning line Y containing the gate electrode of TFT121 and the auxiliary capacity electrode 52 on the glass substrate 101 with a thickness of 0.7mm, a molybdenum-tungsten alloy film, the silicon-oxide film which forms a gate insulator layer and the multilayer of a silicon nitride film, and a semiconductor film of TFT121

[0045] The switching element 121 arranged at the intersection of the signal line X and the scanning line Y, and the signal line X which were arranged by the line writing direction so that two or more scanning lines Y arranged by the line writing direction on the 1 principal plane of a glass substrate 101, these scanning lines Y, and this might cross at right angles is formed.

[0046] Then, a transparent ultraviolet-rays hardening type acrylic resin resist (product made from Fuji Hunt Technology) is applied by 4-micrometer thickness all over this glass substrate 101 using a spinner, and it dries. Then, the photo mask of the predetermined pattern configuration corresponding to the reflective section PR of each pixel field P for this acrylic resin resist is used, and it is 100 mJ/cm2 at the wavelength of 365nm. After exposing with light exposure, negatives are developed for 70 seconds with a predetermined developer. And the bump 161 of 4 micrometers of thickness is formed by calcinating.

[0047] Then, the contact hole penetrated to the source electrode of TFT121 by this bump 161 is formed.

[0048] Then, an aluminum thin film is formed by the sputtering method all over a glass substrate 101. At this time, a bump's 161 contact hole is also filled up with aluminum, and the source electrode of TFT121 and pixel electrode 151R are connected electrically. Then, this aluminum thin film carries out patterning to a predetermined pixel electrode

configuration which remains on a bump 161. From this, reflector, i.e., pixel electrode, 151R is formed on a bump 161.
[0049] Then, a light filter CF is formed all over a glass substrate 101. That is, the ultraviolet-rays hardening type acrylic resin resist (product made from Fuji Hunt Technology) which distributed the red pigment is applied by predetermined thickness all over a glass substrate 101 using a spinner. At this time, this acrylic resin resist has a little the thickness thinner than the thickness in the transparency section PT without a bump 161 in the reflective section PR which has a bump 161, is set as viscosity which is preferably set to 2 about 1/, and has the viscosity of 10cp with the gestalt of this operation.
[0050] And after drying this acrylic resin resist, the photo mask of the configuration corresponding to the red pixel field is used, and it is 100 mJ/cm2 at the wavelength of 365nm. After exposing with light exposure, negatives are developed for 50 seconds with a predetermined developer. And the red light filter CF of thickness predetermined in the transparency section PT and the reflective section PR is formed by calcinating.
[0051] Similarly, the blue light filter CF is formed in a green pixel field to the green light filter CF and a blue pixel field, respectively by the ultraviolet-rays hardening type acrylic resin resist which distributed the green pigment, and the ultraviolet-rays hardening type acrylic resin resist which distributed the blue pigment.
[0052] Then, the contact hole penetrated to the source electrode of TFT121 is formed in this light filter CF.
[0053] Then, an ITO thin film is formed by the sputtering method all over a glass substrate 101. At this time, the contact hole of a light filter CF is also filled up with ITO, and the source electrode of TFT121 and pixel electrode 151T are connected electrically. Then, this ITO thin film carries out patterning to a predetermined pixel electrode configuration which remains in the whole 1-pixel field P. From this, a transparency electrode, pixel electrode 151T [i.e.,], is formed.
[0054] Then, the orientation film 141 is formed by applying AL-1051 (Japan Synthetic Rubber Co., Ltd. make) to the whole surface as an orientation film material, and performing rubbing processing.
[0055] On the other hand, on the glass substrate 201 with a thickness of 0.7mm, a counterelectrode 204 and the orientation film 205 are formed, respectively, and the opposite substrate 200 is formed. The orientation film 205 of the opposite substrate 200 has the orientation shaft of a direction which intersects perpendicularly with the orientation shaft of the orientation film 141 of the array substrate 100.
[0056] Then, except for a liquid crystal inlet, a sealant 106 is printed along the orientation film 205 circumference of the opposite substrate 200. Furthermore, the electrode transition material for supplying voltage to the counterelectrode 204 by the side of [the array substrate 100 side to] the opposite substrate 200 is formed on the electrode transition electrode of the sealant 106 circumference.
[0057] Then, the array substrate 100 and the opposite substrate 200 are arranged and heated, a sealant 106 is stiffened so that the orientation films 141 and 205 may counter mutually, and two substrates are stuck. At this time, a predetermined gap is formed between the array substrate 100 and the opposite substrate 200.
[0058] then, between a liquid crystal inlet to the array substrate 100, and the opposite substrates 200 -- as the liquid crystal constituent 300 -- ZLI-1565 (E. Merck Co. make) -- the chiral agent S811 -- 0.1wt(s)% -- the added thing which was carried out is poured in and a liquid crystal inlet is closed by ultraviolet-rays hardening resin The poured-in liquid crystal constituent 300 forms the pneumatic liquid crystal layer of 90 twist angles with the orientation film 141 by the side of the array substrate 100, and the orientation film 203 by the side of the opposite substrate 200.
[0059] Liquid crystal layer thickness differs in the reflective section PR of the pixel field P, and the transparency section PT. In the reflective section PR, the thickness from the part and glass-substrate 101 front face where the light filter CFR is formed on the bump 161 becomes thicker than the transparency section PT, and liquid crystal layer thickness [in / the transparency section PT / to the liquid crystal layer thickness in the reflective section PR being 2.5 micrometers] is 5 micrometers.
[0060] For this reason, in the transparency section PT, by the time it penetrates the back light light which carried out incidence to the liquid crystal layer from the array substrate side to an opposite substrate side, it will produce lambda/2 of phase contrast. In the reflective section PR, the outdoor daylight which carried out incidence to the liquid crystal layer produces lambda/4 of phase contrast from an opposite substrate side in one way, and by the time outgoing radiation of the reflected light reflected by reflector 151R is carried out to an opposite substrate side, it will produce lambda/2 of phase contrast both ways.
[0061] The laminating of lambda/4 wavelength plate 181 and the polarizing plate 183 is carried out to the superficies of the array substrate 100 at this order. Moreover, the laminating of the diffusion board 207, lambda/4 wavelength plate 209, and the polarizing plate 211 is carried out to the superficies of the opposite substrate 200 at this order.
[0062] The circular polarization of light produced by passing a deflecting plate and passing a phase contrast board is changed into the circular polarization of light of the forward direction or an opposite direction by ON/OFF of the voltage to a liquid crystal layer. Thereby, after passing a phase contrast board again, passage / un-passing a polarizing

plate are chosen. A picture is displayed by penetrating back light light alternatively in a dark place using this. Moreover, in a bright place, a picture is displayed by reflecting outdoor daylight alternatively.

[0063] A transflective LCD equips the 1-pixel field P with the reflective section PR and the transparency section PT. thus, in a bright place It functions as a reflected type liquid crystal display which reflects outdoor daylight alternatively by the reflective section PR, and displays a picture. in a dark place By functioning as a penetrated type liquid crystal display which penetrates alternatively the back light light in which outgoing radiation was carried out by the transparency section PT from the back light unit 30, and displays a picture As compared with the case where a back light unit is always driven as a penetrated type liquid crystal display, it becomes possible to reduce power consumption sharply.

[0064] Moreover, even if it is the case where it is made to function as a reflected type liquid crystal display in a bright place, by making thickness of the light filter CFR in the reflective section PR thinner than the light filter CFT in the transparency section PT, and making the spectral transmittance of a light filter CFR higher than a light filter CFT, it becomes possible to use outdoor daylight effectively. For this reason, even if it is the case where it is made to function as a reflected type liquid crystal display, in a dark place, the good color-reproduction range equivalent to the case where it is made to function as a penetrated type liquid crystal display is realizable.

[0065] Next, the form of other operations of this invention is explained. In addition, about the same component as the form of operation mentioned above, the same reference number is attached and detailed explanation is omitted.

[0066] As shown in drawing 7 and drawing 8 , in the array substrate 100, the reflective section PR of the pixel field P has pixel electrode 151R as a reflector prepared on the glass substrate 101. Moreover, the transparency section PT has pixel electrode 151T as a transparency electrode prepared on the 1st light filter CF 1 prepared on the glass substrate 101, and this 1st light filter CF 1. The optical density of the 1st light filter CF 1 is 1/2, and the thickness is about 2.5 micrometers. For this reason, the transparency section PT of the array substrate 100 is thick by the thickness of this 1st light filter CF 1. That is, the 1st light filter CF 1 has played a bump's 161 role in the form of the operation explained previously shown in drawing 3 and drawing 4 .

[0067] Moreover, in the opposite substrate 200, the reflective section PR of the pixel field P and the transparency section PT have the 2nd light filter CF 2 prepared on the glass substrate 201, and the counterelectrode 204 prepared on this 2nd light filter CF 2. The optical density of the 2nd light filter CF 2 is almost the same as the 1st light filter CF 1, it is 1/2, and the thickness is about 2.5 micrometers. The pixel field P by the side of the opposite substrate 200 is almost flat.

[0068] The optical density of the transparency section of the pixel field P reaches 1st light-filter CF1, and is equivalent to the sum of the optical density of the 2nd light filter CF 2, and the optical density of the reflective section has only the effective optical density of the 2nd light filter CF 2 to being 1, and it is 1/2. In a dark place, at the time of a transparency display, the back light light which carried out incidence to the array substrate side from the back light unit reaches 1st light-filter CF1, and passes the 2nd light filter CF 2 alternatively at it. In a bright place, at the time of a reflective display, it is reflected by reflector 151R and the outdoor daylight which carried out incidence from the opposite substrate side passes the 2nd light filter CF 2 alternatively again, after passing the 2nd light filter CF 2.

[0069] Thus, back light light and outdoor daylight will pass the light filter of equal optical density substantially, and become possible [realizing a color reproduction equivalent to the time of a transparency display at the time of a reflective display].

[0070] Moreover, the pixel field P of the opposite substrate 200 of the pixel field P of the array substrate 100 is [in / the transparency section PT / to being almost flat] thicker than the reflective section PR by the thickness of the 1st light filter CF 1. For this reason, the liquid crystal layer thickness of the reflective section PR is thicker than the liquid crystal layer thickness of the transparency section PT. With the gestalt of this operation, the liquid crystal layer thickness of the reflective section PR is about 7.5 micrometers, and the liquid crystal layer thickness of the transparency section PT is about 5 micrometers.

[0071] When phase contrast which will be produced by the time the back light light which carried out incidence to the liquid crystal layer from the array substrate side penetrates to an opposite substrate side in the transparency section PT is made into lambda/2, for this reason, in the reflective section PR The phase contrast which the outdoor daylight which carried out incidence to the liquid crystal layer produces the phase contrast of lambda/2x3/2=3lambda/4 from an opposite substrate side in one way, and will be produced by the time outgoing radiation of the reflected light reflected by reflector 151R is carried out to an opposite substrate side is set to 3lambda/2 both ways.

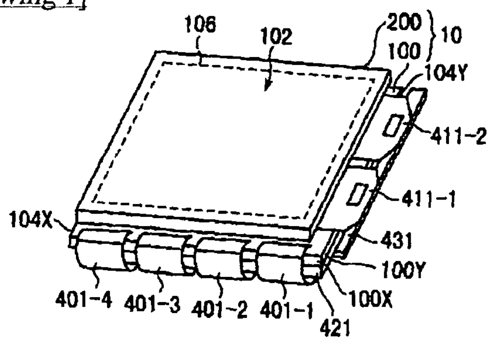
[0072] Like the gestalt of operation mentioned above on the superficies of the array substrate 100, the laminating of lambda/4 wavelength plate 181 and the polarizing plate 183 is carried out to this order, and the laminating of the diffusion board 207, lambda/4 wavelength plate 209, and the polarizing plate 211 is carried out to the superficies of the opposite substrate 200 at this order.

[0073] The circular polarization of light produced by passing a deflecting plate and passing a phase contrast board is changed into the circular polarization of light of the forward direction or an opposite direction by ON/OFF of the voltage to a liquid crystal layer. Thereby, after passing a phase contrast board again, passage / un-passing a polarizing plate are chosen. A picture is displayed by penetrating back light light alternatively in a dark place using this. Moreover, in a bright place, a picture is displayed by reflecting outdoor daylight alternatively.
[0074] As mentioned above, the thickness of the light filter in the reflective section PR as a result by using a light filter as a bump's substitute by making it thinner than the thickness of the light filter in the transparency section PT While it is possible to reduce power consumption sharply like the form of the operation explained previously, even if it is the case where it is made to function as a reflected type liquid crystal display, the same good color-reproduction range as the case where it is made to function as a penetrated type liquid crystal display is realizable.
[0075]
[Effect of the Invention] As explained above, while using the back light light for a transparency display effectively in a dark place according to this invention, in a bright place, the outdoor daylight for a reflective display can be used effectively, a good color reproduction can both be made possible, and the liquid crystal display which can reduce power consumption can be offered.

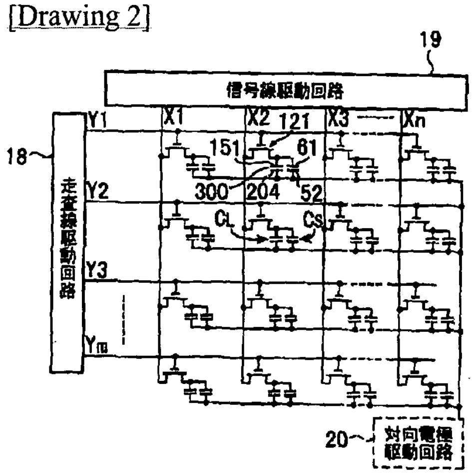
[Translation done.]

DRAWINGS

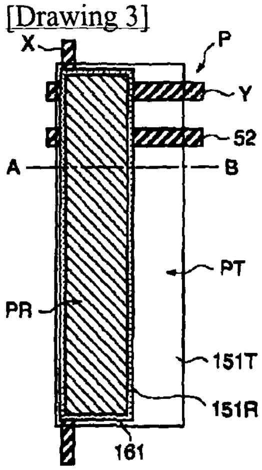
[Drawing 1]



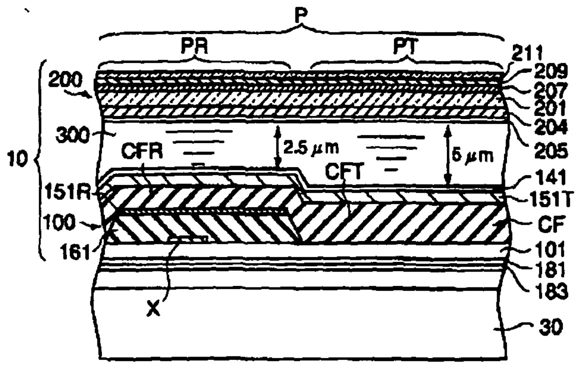
[Drawing 2]



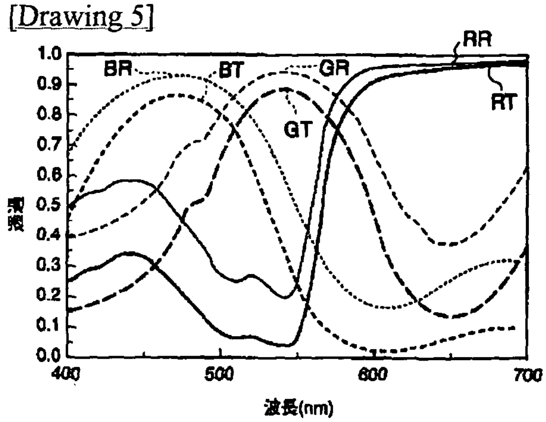
[Drawing 3]



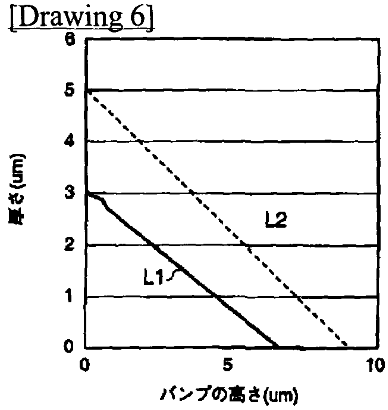
[Drawing 4]



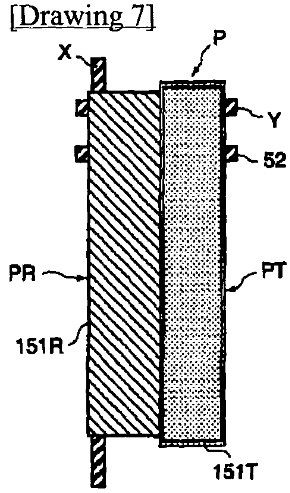
[Drawing 5]



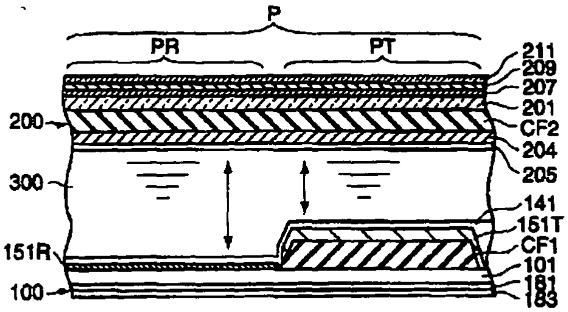
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]